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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/523,353	03/07/2005	Qing Yang	APL-101/US	8302

30869 7590 07/29/2010

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EXAMINER	
NEGIN, RUSSELL SCOTT	
ART UNIT	PAPER NUMBER
1631	

NOTIFICATION DATE	DELIVERY MODE
07/29/2010	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/523,353	YANG, QING	
	Examiner	Art Unit	
	RUSSELL S. NEGIN	1631	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *17 May 2010*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *53-59 and 66-70* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *53-59 and 66-70* is/are rejected.

7)☒ Claim(s) *53* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *5/10/10*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Comments

Applicants' amendments and request for reconsideration in the communication filed on 17 May 2010 are acknowledged and the amendments are entered.

Claims 53-59 and 66-70 are pending and examined in the instant Office action.

Line 6 of claim 68 recites the parameters "BF" and "BV" which are not defined in the claim. While equation 13 on page 18 of the specification gives a possible definition for each quantity, it is recommended that these quantities be defined within claim 68.

Withdrawn Rejections

The objection to claim 53 is withdrawn in view of amendments filed to the instant claim on 17 May 2010.

The rejections of claims 53-70 under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention are withdrawn in view of amendments filed to the instant set of claims on 17 May 2010.

Claim Objections

The following objection is newly applied:

Claim 53 is objected to because of the following informalities:

Lines 36-37 of claim 53 recite "wherein when said $\alpha_2 = 0$ a peak height (PH)=$1/\sigma_2$ and a mean transit time (MTT)=$t_2+\sigma_2$ are used..." which should recite "wherein when said $\alpha_2 = 0$, a peak height (PH)=$1/\sigma_2$ and a mean transit time (MTT)=$t_2+\sigma_2$ are used..." (a comma was inserted into the listing).

Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

INDEFINITENESS

The following rejections are newly applied:

Claims 53-59 and 66-70 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 53 recites the limitation "the number of adjustable parameters" in lines 44-45. There is insufficient antecedent basis for this limitation in the claim. While instant claim 53 recites many parameters, claim 53 is silent as to which and the total of how many of these parameters are capable of being adjusted. While the paragraph bridging pages 19 and 20 of the specification exemplifies four possible adjustable parameters, claim 53 does not define the adjustable parameters to correspond to these four

quantities. For the purpose of examination, it is interpreted that any parameter recited in claim 53 is adjustable.

Claim 53 also begins by reciting "A method for estimating arterial delay and arterial dispersion (t, α, σ) values," wherein it is unclear as to the correspondence of the **two** quantities of arterial delay and arterial dispersion to the **three** quantities in parentheses. In other words, it is unclear at this point in the claim which quantity or quantities of (t, α, σ) corresponds to arterial delay and which quantity or quantities of (t, α, σ) correspond to arterial dispersion.

Claim 58 recites the limitation "said contrast agent C(t)" in line 3. There is insufficient antecedent basis for this limitation in the claim. While there is antecedent basis for "contrast agent," there is no antecedent basis for "contrast agent C(t)." For the purpose of examination "said contrast agent C(t)" is interpreted to encompass the concentration profile of the contrast agent over time.

Claim 66 is indefinite because while lines 3-4 recite "fitting said convolved $AIF_t(t)$ to said measured $AIF_t(t)$," and since all of the arterial input functions in claim 53 are involved in convolutions, it is unclear as to the difference between the convolved $AIF_t(t)$ and the measured $AIF_t(t)$.

Claim 66 is additionally indefinite because the last clause recites "wherein a fitting process is provided by a reduced number of parameters for optimization." This clause is indefinite because as step f of claim 53 already reduces the number of adjustable parameters by calculating a relative dispersion (β_1), it is unclear what further reduction in the number of adjustable parameters is occurring in claim 66. For the

purpose of examination, it is interpreted that the four adjustable parameters of claim 53 are the same adjustable parameters optimized in claim 66.

Claim 70 recites that the parameters E and V_e are additional parameters "optimized with other adjustable parameters." As discussed above with respect to claim 53, since it is unclear as to what constitutes an adjustable parameter, it is also unclear as to with respect to what OTHER parameters that the parameters E and V_e are adjusted.

ENABLEMENT

The following rejection to newly applied:

Claim 70 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claim 70 requires fitting a simulated two-dimensional curve to an experimental two dimensional curve using a minimum of six adjustable parameters; it is not understood how to fit two two-dimensional curves with so many adjustable parameters.

1. Step f of claim 53 recites fitting a simulated concentration profile to a measured profile wherein the number of adjustable parameters is reduced to four. Claim 70 adds the adjustable parameters E and V_e to the four adjustable parameters of claim 53, which increased the number of adjustable parameters to six. Claim 53 and 70

do not teach how to fit the simulated to the measured concentration profiles using six adjustable parameters.

2. Page 5 of the specification undertakes several calculations to limit the number of adjustable parameters to equal four. The specification is silent on fitting the simulated to the empirical concentration curves using more than four adjustable parameters.

3. The reference of Meyer [Journal of Nuclear Medicine, 1989, volume 30, pages 1069-1078; on IDS] also fits an empirical to a simulated curve using a maximum of four parameters [lines 1-6 of column 2 on page 1073 of Meyer] for the analogous process of monitoring a tracer in a blood vessel. Meyer is also silent on fitting two two-dimensional curves accurately using six adjustable parameters.

4. Claim 70 requires fitting a two dimensional simulated concentration profile to a two dimensional empirical concentration profile using six adjustable parameters. The specification executes a series of calculations to limit the number of adjustable parameters for this fitting procedure to not be greater than four. Likewise, analogous calculations in the prior art also have a maximum of four adjustable parameters for fitting a simulated curve to an empirical curve. Consequently, to fit the simulated concentration curve to an empirical concentration curve using six adjustable parameters (i.e. unknowns) as recited in claim 70, a series of guessing for these parameters would

be required for an accurate fit. Such guessing amounts to UNDUE EXPERIMENTATION.

In view of the above, it is the Examiner's position that with the insufficient guidance and working examples and in view of unpredictability and the state of art one skilled in the art could not make and/or use the invention with the claimed breadth without an undue amount of experimentation.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The following rejection is newly applied:

Claims 53-59 and 66-69 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ostergaard et al. [Magnetic Resonance in Medicine, volume 36, 1996, pages 715-725] in view of Ostergaard et al. [Magnetic Resonance in Medicine, volume 36, 1996, pages 726-736] in view of Meyer [Journal of Nuclear Medicine, volume 30, 1989, pages 1069-1078; on IDS] as evidenced by chi-square test [Definition of Chi-square test, Academic Press Dictionary of Science and Technology, 1992] in view of Foley [Analytical Chemistry, 1987, volume 59, pages 1984-1987]. The first

reference of Ostergaard et al. is referred to as Ostergaard et al. (1996a) throughout this Office action. The second reference of Ostergaard et al. is referred to as Ostergaard et al. (1996b) throughout this Office action.

Independent claim 53 is drawn to a method of estimating arterial delay and arterial dispersion vales for blood perfusion indices for a region of interest by operating a computer program on intensity data of a contrast agent over time. The method first comprises measuring a concentration of a contrast agent over time in a region of interest. This part of the method involves back-calculating a arterial transport function and tissue transport function by performing a series of convolutions- one convolution involves convolving one form of an arterial input function with a known vascular transport function; the second convolution involves a different form of the arterial input function with a tissue transport function. The method also comprises simulating a concentration profile of the contrast agent over time in a region of interest. This part of the method involves taking the arterial input function and estimated tissue transport function from the empirical analysis and using these quantities, along with a known simulated transport function and a known simulated tissue impulse residual function, to simulate a concentration profile. Ultimately, the simulated concentration profile has its fit optimized with the measured concentration profile by adjusting four of the parameters involved in this calculation. Each step of this method is performed on a computer.

The article of Ostergaard et al. (1996a) studies high resolution measurement of cerebral blood flow using intravascular tracer bolus passages. Ostergaard et al. (1996a) uses the approaches of mathematics and statistical analyses to theoretically

simulate a tracer bolus through a blood vessel [title, abstract]. Specifically, equation 1 on page 716 of Ostergaard et al. (1996a) conducts a convolution of an arterial input function with a tissue transport function to arrive at a concentration of a tracer as a function of time. Equation 19 on page 718 of Ostergaard et al. (1996a) teaches a proportional relation (i.e. convertible into an equation using a correction constant) with the form of an arterial input function analogous to the equations for h(t) in step a and step d of claim 53. The paragraph before equation 19 on page 718 of Ostergaard et al. (1996a) teaches that this equation is derived using gamma variate functions and dispersive terms. Equation 5 on page 716 of Ostergaard et al. (1996a) teaches the integral equation in step e of claim 53, and this equation relates the tissue transport function h(t) to the derivative of the impulse residue function with respect to time as recited in step c of claim 53. Equation 6 on page 716 of Ostergaard et al. (1996a) relates concentration of the tracer, the arterial input function, and the residue function to blood flow rate F_t; equation 6 on page 716 of Ostergaard et al. (1996a) is similar to the convolution in step e of claim 53 without the correction constant. Ostergaard et al. (1996a) also teaches mean transit time in equation 2 on page 716.

Ostergaard et al. (1996a) does not teach empirical acquisition of concentration profiles of the contract agent "tracer." Ostergaard et al. (1996a) also does not relate peak heights and mean transit times and dispersions. Ostergaard et al. (1996a) also does not explicitly teach a least squares method to optimize the fit of the simulated concentration profile to the empirical concentration profile. Ostergaard et al. (1996a) also does not use a computer for the method of claim 53.

Like Ostergaard et al. (1996a), the article of Ostergaard et al. (1996b) studies high resolution measurement of cerebral blood flow using intravascular tracer bolus passages. However, Ostergaard et al. (1996b) also uses empirical approaches to obtain the concentration profile of a tracer as a function of time [title, abstract]. Specifically, the "Materials and Methods" section on pages 727-729 of Ostergaard et al. (1996b) discusses how data is obtained using MRI. Profiles and images of the contrast agent over time are illustrated in Figures 1 and 2 of Ostergaard et al. (1996b), respectively. This data is analyzed using the same theory taught in Ostergaard et al. (1996a) [see "Theory" section on pages 726-727 of Ostergaard et al. (1996b) and equation 1 of Ostergaard et al. (1996b)].

Ostergaard et al. (1996b) does not relate peak heights and mean transit times and dispersions. Ostergaard et al. (1996b) also does not explicitly teach a least squares method to optimize the fit of the simulated concentration profile to the empirical concentration profile. Ostergaard et al. (1996b) also does not use a computer for the method of claim 53.

The article of Meyer studies corrections for tracer arrival delay and dispersion in cerebral blood flow measurements [title]. Specifically, Figure 1 on page 1072 of Meyer illustrates fitting simulated concentration data of a tracer over time to empirical data of the concentration of a tracer over time. The first 3 lines of text in the second column on page 1073 of Meyer teach that the fitting involves a four-parameter fit wherein four parameters are adjusted to optimize the fit of the simulated to empirical concentration profiles. Lines 3-7 of the text of column 2 on page 1073 of Meyer teach the use of the

chi-square test to assess the goodness of fit of the simulated to the empirical data. The definition of chi-square test teaches that in measuring the value of the chi-square, the sum of the squares of the differences between observed and expected outcomes are calculated (this corresponds to the optimization formula in step f of claim 53).

Meyer does not relate peak heights and mean transit times and dispersions. Meyer also does not use a computer for the method of claim 53.

The article of Foley studies equations for peak modeling and calculation of peak area.

Column 2 on page 1984 of Foley (under "Computations") teaches use of Apple computers and the computer programming language BASIC to calculate the peak areas and peak properties.

Equation 1 on page 1984 of Foley teaches the integral of a modified Gaussian distribution resulting in a gamma function similar to the equation for A_2 in step d of claim 53. Equation 2 on page 1984 of Foley teaches that peak height for a given peak area is inversely proportional to width (a measure of dispersion). Figure 1 on page 1985 of Foley et al. teaches that the mean transit time (the location on the abscissa of the vertical line) is related to the peak time (t_2) and the dispersion (the sum of a and b).

With regard to claim 54, Figure 3a of Ostergaard et al. (1996b) illustrates the generated intensity data after administering the tracer into arteries of the body during a dynamic image scan. Computers are discussed in column 2 on page 1984 of Foley.

With regard to claim 55, Figure 3b of Ostergaard et al. (1996b) illustrates the time course of the arterial tracer intensity data sequentially obtained. The concentration of the tracer in the artery in Figure 3b of Ostergaard et al. (1996b) is plotted against time.

With regard to claim 56, the arterial input function in Figure 3 of Ostergaard et al. (1996b) is based on the injection of the tracer in bolus form into the carotid artery, the MCA, or the posterior cerebral artery feeding the region of interest that is illustrated in Figure 3a of Ostergaard et al. (1996b).

With regard to claim 57, in the absence of a meaning of "scaling upward," any modification of the arterial input function related to a venous input function is interpreted to be encompassed by claim 57. Equation 1 on page 716 of Ostergaard et al. (1996a) scales (by convolution) an arterial input function by a tissue transport function to result in a venous output function. Although the result is termed a "venous output function" in Ostergaard et al. (1996a) and not a venous input function as recited in the instantly rejected claim, this venous output function is based on a measure of input into the vein from the artery and thus is interpreted to be encompassed by the limitations of the claim.

With regard to claim 58, Figure 3b of Ostergaard et al. (1996b) illustrates the concentration profiles as a function of time for the tracer in regions of interest of the body. The title of Ostergaard et al. (1996b) teaches that the tracer is applied as a

"bolus," which suggests that the arterial input function as a function of time is a single injection at an initial time.

With regard to claim 59, equation 5 on page 1071 of Meyer teaches the form of the equation of $h_a(t)$ is step a of claim 53 wherein α is set to zero. This equation also relates time (t) to dispersion (σ is claim 53 and τ in equation 5 of Meyer) to better assess the input function.

With regard to claim 66, Ostergaard et al. (1996b) teaches in equation 1 a convolved arterial input function that is fit to empirical data (such as in Figure 3 of Ostergaard et al. (1996b)) resulting from the arterial input function of a bolus injection (title) to result in optimized parameters that include t_1 and σ_1 (Figure 1 and 2 of Ostergaard et al. (1996b)).

With regard to claims 67-68, model-free deconvolution of equation 1 of Ostergaard et al. (1996b) is taught from line 10 of column 2 on page 728 of to line 2 of column 1 on page 729 of Ostergaard et al. (1996b). The paragraph bridging pages 728 and 729 of Ostergaard et al. (1996b) teaches that ideally, the maximum point on the deconvolution curve corresponds to the initial point. Figure 2B of Ostergaard et al. (1996b) demonstrates the concentration profile and dispersion after a bolus injection using the model free approach of singular value decomposition. Equations 2, 4, and 5 on page 716 of Ostergaard et al. (1996a) relate mean transit time (MMT), blood flow,

and blood volume involved in the convolution of claim 68 (corresponding to equation 1 in Ostergaard et al. (1996a)) using integration (equations 2 and 5) and quotients (equation 4).

With regard to claim 69, equation 2 on page 1070 of Meyer use an extraction/partition coefficient for tissue to blood of p_i, and a constant k dependent on the flow rate and this extraction coefficient. Likewise, equation 7 on page 717 of Ostergaard et al. (1996a) teaches an exponential dependence of the residual function on mean transit time (MTT).

It would have been obvious to someone of ordinary skill in the art at the time of the instant invention to modify the theoretical techniques of assessing a tracer agent as a function of time in Ostergaard et al. (1996a) by use of the empirical techniques of assessing a tracer agent as a function of time in Ostergaard et al. (1996b) wherein the motivation would have been that the empirical data of Ostergaard et al. (1996b) [i.e. Figure 3] provides actual experimental data for which the theoretical data can be tested for accuracy.

It would have been further obvious to someone of ordinary skill in the art at the time of the instant invention to modify the theoretical and experimental techniques of assessing a tracer agent as a function of time in Ostergaard et al. (1996a) and Ostergaard et al. (1996b) by use of the chi-square testing with four adjustable parameters as in Meyer because it is obvious to combine known elements in the prior

art to yield a predictable result. In this instance, the optimization technique of Meyer is an alternative to the fitting procedures in Ostergaard et al. (1996a) and Ostergaard et al. (1996b). There would have been a reasonable expectation of success in combining Ostergaard et al. (1996a), Ostergaard et al. (1996b), and Meyer because all three studies analogously pertain to measuring and modeling concentrations of tracer agents as a function of time.

It would have been further obvious to someone of ordinary skill in the art at the time of the instant invention to modify the theoretical and experimental techniques of assessing a tracer agent as a function of time in Ostergaard et al. (1996a) and Ostergaard et al. (1996b), the chi-square testing with four adjustable parameters as in Meyer, by use of the relations for Gaussian peak areas and the relations between time, dispersion (peak width), intensity (peak height and area) of Foley wherein the motivation would have been that Foley provides a quantitative assessment of area calculation and the correct proportionalities between constants. There would have been a reasonable expectation of success in combining Ostergaard et al. (1996a), Ostergaard et al. (1996b), Meyer, and Foley because the assessments of the quantitative properties with regard to peak shape are generally applicable to the peaks of the tracers in Ostergaard et al. (1996a), Ostergaard et al. (1996b), and Meyer.

It would have been further obvious to someone of ordinary skill in the art at the time of the instant invention to modify the dispersions/peak widths of Ostergaard et al. (1996a), Ostergaard et al. (1996b), Meyer, and Foley by use of a relative dispersion because it is obvious to substitute known elements in the prior art to yield a predictable

result. In this instance, a relative dispersion is an alternative (and dimensionless) way of measuring the same quantity as an actual dispersion. There would have been a reasonable expectation of success in modifying the actual dispersions/peak widths of Ostergaard et al. (1996a), Ostergaard et al. (1996b), Meyer, and Foley by use of a relative dispersion because relative dispersions are calculated based on a ratio of properties already measured or calculated (peak injection time and actual dispersion).

Response to Arguments

Applicant's arguments with respect to the instantly set of claims have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

No claim is allowed.

Papers related to this application may be submitted to Technical Center 1600 by facsimile transmission. Papers should be faxed to Technical Center 1600 via the central PTO Fax Center. The faxing of such pages must conform with the notices published in the Official Gazette, 1096 OG 30 (November 15, 1988), 1156 OG 61 (November 16, 1993), and 1157 OG 94 (December 28, 1993)(See 37 CFR § 1.6(d)). The Central PTO Fax Center Number is (571) 273-8300.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Russell Negin, whose telephone number is (571) 272-

1083. The examiner can normally be reached on Monday-Friday from 8:30 am to 5:30 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's Supervisor, Marjorie Moran, Supervisory Patent Examiner, can be reached at (571) 272-0720.

Information regarding the status of the application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information on the PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Russell S. Negin/
Examiner, Art Unit 1631
23 July 2010